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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

DOCKET #: 4070-57PUS

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

				U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
				09/763048

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/05619	August 03, 1999	August 14, 1998

TITLE OF INVENTION

Method and Device for a Full-Duplex Radio Transmission System With Code Division Multiple Access

APPLICANT(S) FOR DO/EO/US

Andreas HACHENBERGER; Klaus JÄCKEL; Mathias REIBE; Reinhard SCHIFFEL; Joachim SEIDEL;

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [x] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [x] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [x] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [x] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.
8. [x] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [x] An EXECUTED oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. Below concern other document(s) or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [x] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x] A **FIRST** preliminary amendment.
    [] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [] A substitute specification.
15. [] A change of power of attorney and/or address letter.
16. [x] Other items or information *(specify)*: PCT Publication Sheet, Int'l Preliminary Examination Report, Int'l Search Report, Int'l Preliminary Search Report with Notification re same, Notification of Transmittal of International Preliminary Examination Report

U.S APPLICATION NO (If known, see 37 C F R 1 5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/763048	PCT/EP99/05619	4070-57PUS

17.[x]The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):
Search Report has been prepared by the EPO or JPO **$860.00**
International preliminary examination fee paid to USPTO (37 CFR 1.482)..... **$690.00**
No international preliminary examination fee paid to USPTO (37 CFR 1.482)
but international search fee paid to USPTO (37 CFR 1.445(a)(2)) **$710.00**
Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$1000.00**
International preliminary examination fee paid to USPTO (37 CFR 1.482)
and all claims satisfied provisions of PCT Article 33(2)-(4) **$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =				**$860**	
Surcharge of **$130.00** for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				**$**	
Claims	Number Filed	Number Extra	Rate		
Total Claims	10 - 20 =	0	x **$18.00**	**$**	
Independent Claims	2 - 3 =	0	x **$80.00**	$	
Multiple dependent claim(s) (if applicable)			+ **$270.00**	**$**	
TOTAL OF ABOVE CALCULATIONS =				**$860**	
Reduction of ½ for filing by small entity, if applicable.				**$430**	
SUBTOTAL =				**$430**	
Processing fee of **$130.00** for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				**$**	
TOTAL NATIONAL FEE =				**$430**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				**$**	
TOTAL FEES ENCLOSED					$430
Amount to be refunded:					**$**
charged:					**$**

a. [x]One check in the amount of $ 430 to cover the above fees is/are enclosed.
b. [] Please charge my Deposit Account No. 03-2412 in the amount of $____ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. [x]The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
Klaus P. Stoffel
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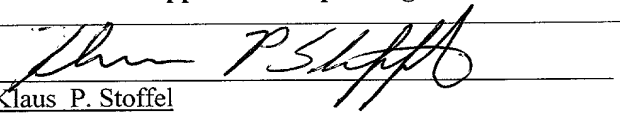

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By Express Mail # EL 727707794 US · February 14, 2001

Attorney Docket # 4070-57PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Andreas HACHENBERGER et al.

International Appln. No.: PCT/EP99/05619

International Filing Date: August 03, 1999

For: Method and Device for a Full-Duplex Radio Transmission System With Code Division Multiple Access

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to the issuance of a first Office Action and simultaneously with the filing of the present application, please amend said application as follows:

In the Specification:

Page 1, line 3, insert --BACKGROUND OF THE INVENTION--.

Page 3, the paragraph starting at line 13:

Various methods are known which reduce the previously described disadvantage of the asynchronous CDMA methods, for example the synchronization of the external station in such

a way that its transmission can be processed in synchronism with the chip in the receiver of the base station. In addition, it has been proposed to implement interference [concelers] cancelers which, by means of mathematical algorithms, subsequently eliminate the interference component for the parallel transmissions on the basis of different a priori or a posteriori knowledge. Furthermore, it has also been proposed to use multi-user detectors. A disadvantage of all these known methods is that they are very costly to implement.

line 24, insert --SUMMARY OF THE INVENTION--;

the paragraph starting at line 33:

[The technical problem is solved by means of the features of patent claims 1 and 9.] It is necessary for the radio transmission system to be operating in time division duplex mode in which transmission and reception are separated from one another in terms of time within one telecommunications channel, which significantly simplifies the sequence control. In order to synchronize all the subscriber stations, the radio base station transmits a maximum sequence or gold sequence, specific to the radio transmission system, in the form of a preamble for all the subscriber stations before the actual data transmission. Since the information on the direct subscriber-specific system control, such as, for example, call setup and the like is transmitted in a central service channel, a common preamble can be used for all the subscriber stations. This preamble can be detected without restricting other system parameters with a significantly better signal/noise ratio, since multi-user interference is not present and the subscriber-specific signal

powers can be transmitted in an additive, coherent fashion, which brings about a high level of detection reliability in the subscriber stations. The preamble which is received there is fed to a matched or correlation filter whose output signal serves as a trigger criterion when a defined amplitude threshold value is exceeded. [Further advantageous refinements of the invention emerge from the subclaims.]

Page 6, between line 16 and line 17, insert --BRIEF DESCRIPTION OF THE DRAWINGS--;

Between line 37 and line 38, insert --DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

Page 7, the paragraph starting at line 23:

In order to determine a first item of synchronization information, the preamble 1 which is received by each subscriber station is fed a matched filter [[sic]] by means of which the reception quality can be determined. A typical signal. Profile at the output of the matched filter of a subscriber station is illustrated in Fig. 3. In order to determine the reception time of the transmission from the radio base station to the respective subscriber station, the output signal at the matched filter is evaluated by means of an amplitude threshold value switch. If the output signal exceeds a predefinable threshold Trl, the amplitude threshold value switch produces a trigger signal[,] that [[sic]] represents the starting time for the reception of the preamble.

--Thus, while there have been shown and described and pointed out fundamental novel features of the present invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the present invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is also to be understood that the drawings are not necessarily drawn to scale but that they are merely conceptual in nature. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.--

Page 10, starting at line 1:

[[List of reference numerals

1) Preamble

2) Data item

3) Synchronization sequence

4) User data

5) Symbol]

In the Claims:

Please cancel claims 1-10 and add the following new claims:

11. A method for synchronization in a full-duplex-capable radio transmission system with CDMA access with TDD mode, having a central radio base station and a plurality of subscriber stations which are independent of one another, a matched filter with a downstream amplitude threshold value switch being assigned in each case to the individual subscriber stations at a receiver end, the method comprising the steps of:

a) generating a preamble at the radio base station by spreading with a specific maximum sequence or gold sequence which is uniform for the radio transmission system;

b) transmitting the preamble synchronously in all telecommunications channels to all subscriber stations before actual user data transmission;

c) receiving the preamble at the subscriber stations;

d) feeding the received preamble to an input of the respective matched filter of a subscriber station;

e) forwarding an output signal of the matched filter to the amplitude threshold value switch; and

f) generating a trigger signal at the amplitude threshold value switch when a predefinable threshold Tr_1 is exceeded.

12. A method as defined in claim 11, further including averaging over time at the subscriber station synchronization information which is determined by means of a priori knowledge of burst structure and duration.

13. A method as defined in claim 11, including providing the radio base station with a matched filter with a downstream amplitude threshold value switch, and in each case transmitting from a subscriber station a specific synchronization sequence to the radio base station within a delay time of the actual user data transmission, receiving the synchronization sequence at the radio base station and determining concrete signal transit time between the radio base station and the corresponding subscriber station by matched filtering with an upper transgression of an amplitude threshold value being evaluated as a trigger criterion at the filter output.

14. A method as defined in claim 13, wherein the step of transmitting the synchronization sequence includes transmitting the synchronization sequence comprising a preamble and a plurality of identical symbols which are spread with subscriber-specific or radio-system-specific maximum sequences or gold sequences, the individual symbols being transmitted shifted successively by one system clock t_{sample} with respect to one another in each case, the radio base station using all the amplitude values at the output of the matched filter at precise times of the symbol change for evaluation purposes, and using a time when an amplitude threshold value is exceeded when a preamble is received as a reference time value.

15. A method as defined in claim 13, including transmitting a status signal from the radio base station to the subscriber station via the central service channel, the status signal specifying which subscriber station is to transmit its synchronization sequence, and, after the evaluation of the signal transmit time determined in the radio base station, transmitting an item of information to the respective subscriber station via the service channel, said item of information specifying at which subscriber-specific starting times the transmission of user data or control information in an uplink should start so that parallel transmissions of all the subscriber stations are received in synchronism with a chip in the receiver of the radio base station.

16. A method as defined in claim 14, including using orthogonal gold sequences of a length of one symbol in each case for the code spreading of the data both in an uplink and in a downlink.

17. A method as defined in claim 11, wherein adjacent radio transmission systems at least one of operate in different frequency positions, use different spread sequences in each case and use spread sequences from different code families.

18. A method as defined in claim 17, including operating respective radio base stations of the adjacent radio transmission systems synchronously with one another in an uplink cycle and in a downlink cycle.

19. A device for synchronization within a full-duplex-capable radio transmission system with CDMA access with TDD mode, comprising: a central radio base station; a plurality of subscriber stations which are independent of one another; a matched filter with an amplitude threshold value switch assigned to each subscriber station at a reception end; and at least one matched filter with an amplitude threshold value switch assigned to the radio base station at a reception end, the radio base station being operative to generate a preamble by spreading with a specific maximum sequence or gold sequence which is uniform for the radio transmission system, said preamble being transmittable synchronously in all telecommunications channels from an actual user data transmission to the subscriber station.

20. A device as defined in claim 19, wherein the radio transmission system is a wireless local loop system.

REMARKS

The present amendment is submitted prior to the issuance of a first Office Acton and simultaneously with the filing of the present application.

With this amendment applicants have amended the specification, cancelled claims 1 to 10 and added new claims 11 to 20, all in an effort to place the application in better condition for examination.

Favorable action on the present application is respectfully requested.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By: 

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14 February 2001

IN THE SPECIFICATION:

Page 3, starting at line 13:

Various methods are known which reduce the previously described disadvantage of the asynchronous CDMA methods, for example the synchronization of the external station in such a way that its transmission can be processed in synchronism with the chip in the receiver of the base station. In addition, it has been proposed to implement interference cancelers which, by means of mathematical algorithms, subsequently eliminate the interference component for the parallel transmissions on the basis of different a priori or a posteriori knowledge. Furthermore, it has also been proposed to use multi-user detectors. A disadvantage of all these known methods is that they are very costly to implement.

starting at line 33:

It is necessary for the radio transmission system to be operating in time division duplex mode in which transmission and reception are separated from one another in terms of time within one telecommunications channel, which significantly simplifies the sequence control. In order to synchronize all the subscriber stations, the radio base station transmits a maximum sequence or gold sequence, specific to the radio transmission system, in the form of a preamble for all the subscriber stations before the actual data transmission. Since the information on the direct subscriber-specific system control, such as, for example, call setup and the like is transmitted in a central service channel, a common preamble can be used for all the subscriber stations. This preamble can be detected without restricting other system parameters with a significantly better signal/noise ratio, since multi-user interference is not present and the subscriber-specific signal

powers can be transmitted in an additive, coherent fashion, which brings about a high level of detection reliability in the subscriber stations. The preamble which is received there is fed to a matched or correlation filter whose output signal serves as a trigger criterion when a defined amplitude threshold value is exceeded.

Page 7, starting at line 23:

In order to determine a first item of synchronization information, the preamble 1 which is received by each subscriber station is fed a matched filter by means of which the reception quality can be determined. A typical signal. Profile at the output of the matched filter of a subscriber station is illustrated in Fig. 3. In order to determine the reception time of the transmission from the radio base station to the respective subscriber station, the output signal at the matched filter is evaluated by means of an amplitude threshold value switch. If the output signal exceeds a predefinable threshold Trl, the amplitude threshold value switch produces a trigger signal that represents the starting time for the reception of the preamble.

Method and device for a full-duplex-capable radio transmission system with CDMA access

The invention relates to a method and a device for a full-duplex-capable radio transmission system with CDMA access, having a central radio base station and a plurality of subscriber stations which are independent of one another.

In the field of radio-supported information systems which operate with a central radio base station and a plurality of external stations or subscriber stations which are independent of one another and which permit information to be transmitted in full duplex form in both directions, the information in the downlink which is intended for the individual users is frequently multiplexed into a telecommunications channel and transmitted organized as an access system in the uplink. Examples of such systems are mobile radio systems, public trunked mobile radio systems, point-to-multipoint microwave radio systems and wireless local loop systems. Orthogonal signal domains which differ from one another are used in each case for the multiplexing or multiple access, these signal domains being, for example,

- frequency division multiplex or access systems FDMA (frequency division multiple access)
- time division multiplex or access systems TDMA (time division multiple access)
- code division multiplex or access systems CDMA (code division multiple access) or SSMA (spread spectrum multiple access)
- space-division multiplex or access systems.

The systems differ in that the transmission of information from and to the individual users takes place in separate frequency, time, code or spatial segment positions. Interleaved, coupled or respectively different multiplex and access technologies within one system, so-called hybrid methods, have become known. Depending on the use and implementation, different transmission

parameters and transmission quality criteria can be obtained with these methods.

In CDMA systems, the user signal is coded by gating it with a spread function using logic operations, a separate spread function which is orthogonal to the other spread functions being selected for each subscriber station. The logic operation is carried out here in each case by means of an X-OR gate, for example. At the receiver end, the coded signal can be demodulated through knowledge of the associated spread function, the coded user data for other subscriber stations becoming zero during the demodulation process owing to the orthogonality. It is particularly advantageous with CDMA systems that all the users can operate in the same frequency band and a relatively high degree of interference power in the band can be tolerated. Furthermore, under certain conditions it is possible that adjacent radio cells can operate on the same frequency band. It is generally a disadvantage that the multi-user interference, which arises in practice as a result of implementation problems such as band limitation, level differences between the individual transmissions, multi-path propagation etc. and which leads to a loss of orthogonality. In the radio systems under consideration, it is to be noted basically that because of the different signal transmit times owing to different distances between the external stations and the central station an asynchronous reception situation is normally produced in the base station receiver, which situation considerably aggravates this interference to such an extent that under ideal conditions code orthogonality is then no longer produced in the uplink. In this case, the maximum number of simultaneous transmissions M within a frequency band in the uplink of, by approximation, a DS-CDMA system can be estimated as follows:

$$M = PG/(E_b/N_0),$$

PG being the process gain or spread factor and E_b/N_0 being the ratio of bit energy to interference power, necessary for the aimed-at bit error rate, at the demodulator. The spread factor is the ratio of t_{bit} to t_{chip} and is typically between 10^1 and 10^4.

Assuming the ratio E_b/N_0 is, for example, 3, which corresponds to approximately 5 dB, only approximately 1/3 of the transmission capacity, based on the same bandwidth being seized, is available in the uplink in comparison with the downlink or in comparison with TDMA or FDMA systems if orthogonal signals are assumed for the latter.

Various methods are known which reduce the previously described disadvantage of the asynchronous CDMA methods, for example the synchronization of the external station in such a way that its transmission can be processed in synchronism with the chip in the receiver of the base station. In addition, it has been proposed to implement interference concelers which, by means of mathematical algorithms, subsequently eliminate the interference component of the parallel transmissions on the basis of different a priori or a posteriori knowledge. Furthermore, it has also been proposed to use multi-user detectors. A disadvantage of all these known methods is that they are very costly to implement.

The invention is therefore based on the technical problem of providing a method and a device for synchronization in a radio transmission system with CDMA access, by means of which method and device the multi-user interference in the radio base station in the uplink mode can be reduced with low cost in terms of implementation.

The technical problem is solved by means of the features of patent claims 1 and 9. It is necessary for the radio transmission system to be operating in time division duplex mode in which transmission and reception are separated from one another in terms of time within one telecommunications channel, which significantly simplifies the sequence control. In order

to synchronize all the subscriber stations, the radio base station transmits a maximum sequence or gold sequence, specific to the radio transmission system, in the form of a preamble for all the subscriber stations before the actual data transmission. Since the information on the direct subscriber-specific system control, such as, for example, call setup and the like is transmitted in a central service channel, a common preamble can be used for all the subscriber stations. This preamble can be detected without restricting other system parameters with a significantly better signal/noise ratio, since multi-user interference is not present and the subscriber-specific signal powers can be transmitted in an additive, coherent fashion, which brings about a high level of detection reliability in the subscriber stations. The preamble which is received there is fed to a matched or correlation filter whose output signal serves as a trigger criterion when a defined amplitude threshold value is exceeded. Further advantageous refinements of the invention emerge from the subclaims.

The averaging over time of the synchronous information which is determined, and the evaluation of the knowledge of the precise value between two successive preambles, makes it possible to achieve substantially greater precision, given sufficient clock stability in the subscriber stations, since an uncertainty in terms of timing of up to 0.5 x chip duration t_{chip} can occur with simple detection using a matched filter.

The transmission of the synchronous information in the uplink parallel to the transmission of user data is made more difficult by the fact that the synchronous information is a priori not known, or not known sufficiently precisely, as a result of which its acquisition would lead to an asynchronous interference situation with respect to the actual user data transmission. In order to avoid this, in each case only one item of synchronous information for all the

subscriber stations which are active in parallel is transmitted simultaneously in the delay time between the transmission cycle and reception cycle, as a result of which the time information can be detected more reliably because the transmission is subject to significantly less interference. For this purpose, if appropriate the delay time must be extended somewhat, but this is acceptable in order to achieve improved detection.

As a result of the transmission-end shifting of the symbols by one sample value in each case, but [lacuna] symbol-based matched filtering, with fixed timing, in the receiver of the base station, the time resolution or precision of the synchronization information within only one burst is improved up to a sample value t_{sample}, which, in the case of conventional detection, can be up to 0.5 x chip duration t_{chip}.

In order to avoid data collisions, the radio base station transmits to the subscriber station via the central service channel a status signal specifying which subscriber stations are to transmit their synchronization sequence consecutively. After the evaluation of the signal transmit time by the radio base station, said station transmits via the service channel the subscriber-specific starting times for the uplink transmission.

In a further preferred refinement of the method, orthogonal gold sequences of the length of one symbol in each case are used for the code spreading of the data both in the uplink and in the downlink, said sequences being relatively easy to generate. Furthermore, the orthogonal gold sequences have defined cross-correlation properties, the result of which is the subscriber stations, in which the synchronization mechanism fails, do not cause any significant faults in the other parallel transmissions. Furthermore, in comparison with Walsh sequences and similar sequences, these have the advantage of a uniform spectral power distribution, which is significant in particular in the case of short sequences.

It is advantageous for the design of cellular structures if all the radio base stations which lie in the range of mutual radio influence are synchronized in terms of the transmission/reception cycle. In particular radio base stations or subscriber stations which are in line-of-sight with respect to one another owing to an exposed geographical position could otherwise give rise to considerable interference at the receivers of the respective other radio cells. The synchronization may be carried out, for example, by means of GPS or beacon signals which are passed on within the radio network.

The method can be particularly advantageously implemented in wireless local loop systems, since in these systems the stationary nature of the subscriber stations with relatively small changes of the properties of the radio channel over time can be exploited.

The invention is explained in more detail below with reference to a preferred exemplary embodiment.

Fig. 1 shows a signal profile of a transmission in the downlink for a subscriber station,

Fig. 2 shows a signal profile of a transmission in the downlink for n subscriber stations,

Fig. 3 shows a schematic signal profile at the output of a matched filter in a subscriber station,

Fig. 4 shows an illustration of the polling method for the synchronization in the uplink,

Fig. 5 shows a structure of an uplink synchronization sequence,

Fig. 6 shows a detailed illustration of the structure according to Fig. 5, and

Fig. 7 shows a schematic signal profile at the output of a matched filter of a radio base station.

Fig. 1 illustrates a schematic signal profile of a transmission of a radio base station to a subscriber

station over time t. The signal comprises a preamble 1 and a data item 2 which are transmitted with an amplitude P_T. The preamble 1 is in this case a radio-system-specific maximum sequence or gold sequence which is generated by the radio base station. The data item 2 constitutes the actual user data for the subscriber station. Since the information is transmitted for the purpose of direct subscriber-specific system control in a central service channel, a common preamble 1 can be used for all the subscriber stations.

Fig. 2 illustrates the signal profile of the transmission in the downlink for all n subscriber stations. Since the radio base station transmits simultaneously to all n subscriber stations, a corresponding superimposition of the signal profiles occurs. Owing to the transmission of a common preamble 1 for all the subscriber stations into a service channel, a coherent addition occurs and the amplitude is $P_1 \sim n^2 P_T$. The superimposition of the user data takes place in accordance with the code modulation which is used, and varies correspondingly in amplitude, on average approximately the following is true $P_2 \sim nP_T$.

In order to determine a first item of synchronization information, the preamble 1 which is received by each subscriber station is fed a matched filter [sic] by means of which the reception quality can be determined. A typical signal profile at the output of the matched filter of a subscriber station is illustrated in Fig. 3. In order to determine the reception time of the transmission from the radio base station to the respective subscriber station, the output signal at the matched filter is evaluated by means of an amplitude threshold value switch. If the output signal exceeds a predefinable threshold Tr1, the amplitude threshold value switch produces a trigger signal, that [sic] represents the starting time for the reception of the preamble.

Fig. 4 illustrates the signal profiles for the synchronization in the uplink. In order to avoid inter-

ference, the transmission of synchronization sequences 3 by the individual subscriber stations takes place here in the form of a polling method, i.e. in the first burst only the first subscriber station transmits its synchronization sequence 3 to the radio base station. Subsequently, all n subscriber stations then transmit their user data 4 simultaneously to the radio base station. In the second burst, only the second subscriber station then transmits its synchronization sequence 3, until finally in the n-th burst the n-th subscriber station transmits its synchronization sequence 3.

A more precise structure of the synchronization sequence 3 is illustrated in Fig. 5. The synchronization sequence 3 comprises, for example, four identical symbols 5 which are transmitted successively, the distance between the symbols 5 being increased successively by one clock pulse t_{sample} of the system clock, and the first symbol 5 serving as preamble.

An exemplary profile of a symbol 5 is illustrated in Fig. 6, and it corresponds to the second symbol 5 with the transition to the third symbol 5 according to Fig. 5.

Figure 7 illustrates an exemplary signal profile at the output of a matched filter in the radio base station when a synchronization sequence 3 according to Fig. 5 is received. Here, each of the four symbols 5 produces an output signal with an amplitude P which is larger than a predefined threshold value Tr2 of a downstream amplitude threshold value switch. The first symbol 5 produces an output signal with the amplitude Pb. The second symbol 5 which is transmitted directly after the first symbol 5 also produces an amplitude Pb. The third symbol 5 which is delayed by a system clock pulse t_{sample} produces an amplitude Pa, and the symbol 5 which is correspondingly delayed by 2 x t_{sample} produces an amplitude Pc. The optimum reception is therefore that of the third symbol 5 so that the signal transit time has to be corrected correspondingly by one system clock pulse t_{sample}. In this way, the transit time between a

subscriber station and the radio base station can be determined with corresponding precision so that the synchronization can also be performed in the order of magnitude of t_{sample}.

List of reference numerals

1) Preamble
2) Data item
3) Synchronization sequence
4) User data
5) Symbol

19836888.7-35
Q-cell GmbH
27.07.2000

Patent Claims:

1. A method for synchronization in a full-duplex-capable radio transmission system with CDMA access with TDD mode, having a central radio base station and a plurality of subscriber stations which are independent of one another, in each case a matched filter with a downstream amplitude threshold value switch being assigned in each case to the individual subscriber stations at the receiver end, comprising the following method steps:

a) a preamble (1) is generated by the radio base station by spreading with a specific maximum sequence or gold sequence which is uniform for the radio transmission system,

b) the preamble is transmitted synchronously in all telecommunications channels to all subscriber stations before the actual user data transmission (2),

c) the preamble (1) is received by the subscriber stations,

d) the received preamble (1) is fed to the input of the respective matched filter of a subscriber station,

e) the output signal of the matched filter is forwarded to the amplitude threshold value switch, and

f) a trigger signal is generated by the amplitude threshold value switch when a predefinable threshold Tr_1 is exceeded.

2. The method as claimed in claim 1, characterized in that the subscriber stations carry out averaging over time of the synchronization information which is determined, by means of a priori knowledge of the burst structure and duration.

3. The method as claimed in claim 1 or 2, characterized in that the radio base station is designed

with a matched filter with a downstream amplitude threshold value switch, and in each case a subscriber station transmits a specific synchronization sequence (3) to the radio base station within the delay time of the actual user data transmission (4), the radio base station receives the synchronization sequence (3) and determines the concrete signal transit time between the radio base station and the corresponding subscriber station by matched filtering with the upper transgression of an amplitude threshold value being evaluated as a trigger criterion at the filter output.

4. The method as claimed in claim 3, characterized in that the synchronization sequence (3) comprises a preamble and a plurality of identical symbols (5) which are spread with subscriber-specific or radio-system-specific maximum sequences or gold sequences, the individual symbols (5) being transmitted shifted successively by one system clock t_{sample} with respect to one another in each case, and the radio base station uses all the amplitude values at the output of the matched filter at the precise times of the symbol change for evaluation purposes, the time when an amplitude threshold value is exceeded when a preamble is received being used as a reference time value.

5. The method as claimed in claim 3 or 4, characterized in that the radio base station transmits to the subscriber station via the central service channel a status signal specifying which subscriber station is to transmit its synchronization sequence (3), and after the evaluation of the signal transit time determined in the radio base station an item of information is transmitted to the respective subscriber station via the service channel, said item of information specifying at which subscriber-specific starting times the transmission of user data or control information in the uplink should start so that the parallel transmissions of all the subscriber stations

are received in synchronism with the chip in the receiver of the radio base station.

6. The method as claimed in one of the preceding claims, characterized in that orthogonal gold sequences of the length of one symbol in each case are used for the code spreading of the data both in the uplink and in the downlink.

7. The method as claimed in one of the preceding claims, characterized in that adjacent radio transmission systems operate in different frequency positions and/or use different spread sequences in each case and/or use spread sequences from different code families.

8. The method as claimed in claim 7, characterized in that the respective radio base stations of the adjacent radio transmission systems operate synchronously with one another in the uplink cycle and in the downlink cycle.

9. A device for synchronization within a full-duplex-capable radio transmission system with CDMA access with TDD mode, comprising a central radio base station and a plurality of subscriber stations which are independent of one another, a matched filter with amplitude threshold value switch being assigned to each subscriber station at the reception end and at least one matched filter with amplitude threshold value switch being assigned to the radio base station at the reception end, characterized in that a preamble can be generated in the radio base station by spreading with a specific maximum sequence or gold sequence which is uniform for the radio transmission system and said preamble can be transmitted synchronously in all telecommunications channels from [sic] the actual user data transmission to the subscriber station.

10. The device as claimed in claim 9, characterized in that the radio transmission system is designed as a wireless local loop system.

FIG.1

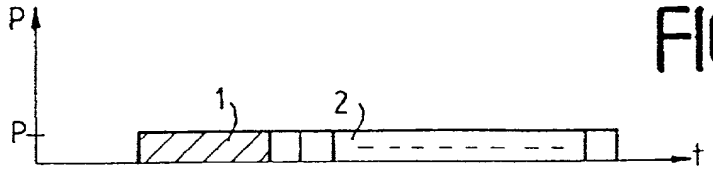


FIG.2

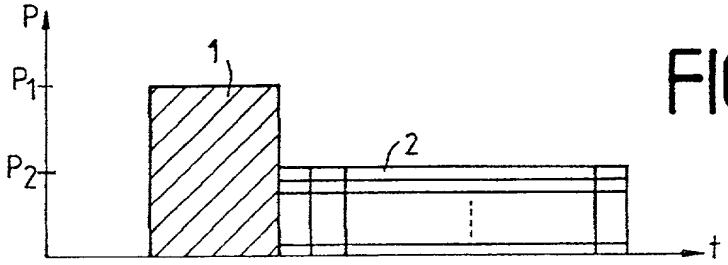


FIG.3

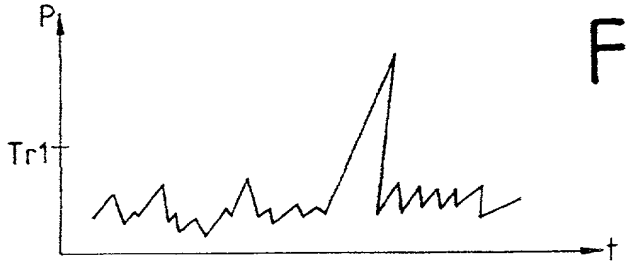


FIG.4

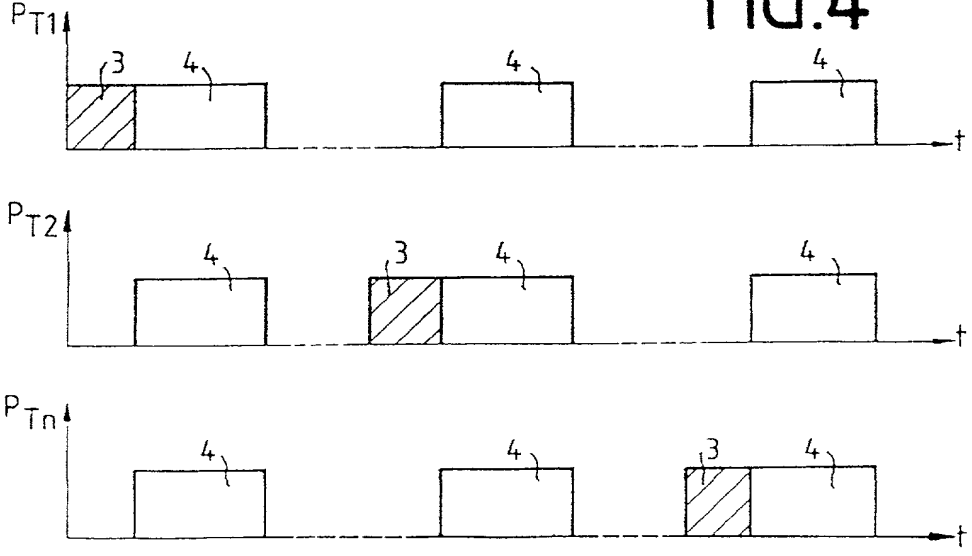


FIG.5

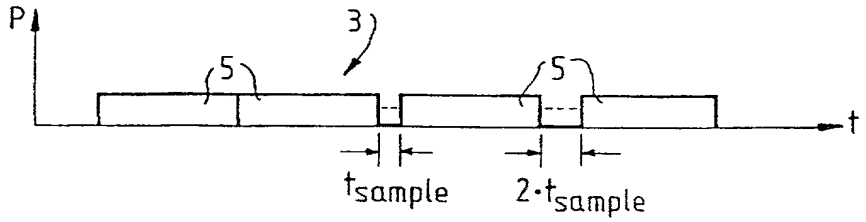


FIG.6

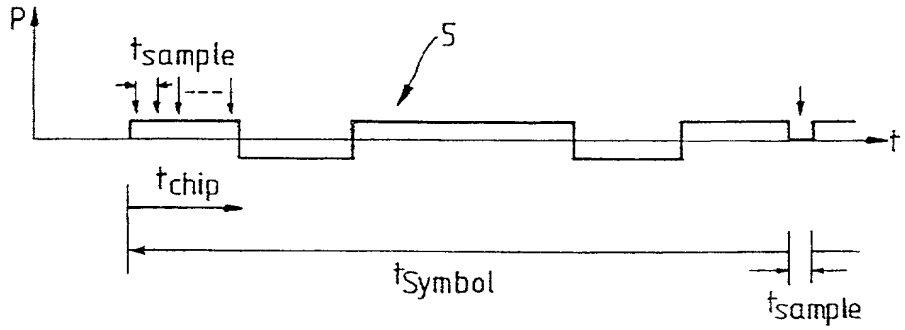
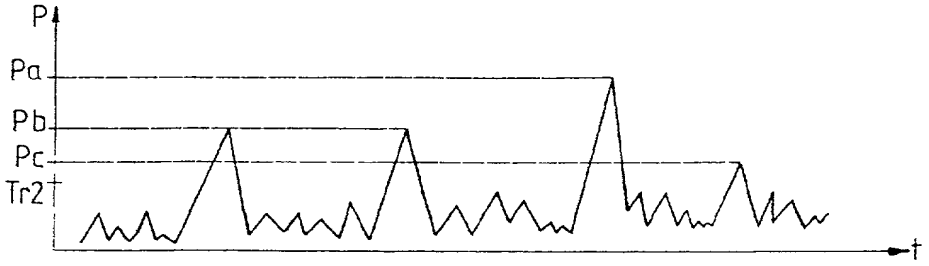


FIG.7



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY Includes Reference to PCT International Applications	Attorney's Docket 4070-57PUS

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND DEVICE FOR A FULL-DUPLEX RADIO TRANSMISSION SYSTEM WITH CODE DIVISION MULTIPLE ACCESS

the specification of which (check only one item below)

[ ] is attached hereto

[ ] was filed as United States application

Serial No.

On

And was amended

On _ (if applicable).

[x] was filed as PCT international application

Number PCT/EP99/05619

On 3 August 1999

And was amended under PCT Article 19

on _ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Germany	198 36 888.7	14 August 1998	[x] YES	[ ] NO
PCT	PCT/EP99/05619	3 August 1999	[x] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO
			[ ] YES	[ ] NO

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Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)	Attorney's Docket. 4070-57PUS

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS			STATUS *(check one)*		
U.S. APPLICATION NUMBER		U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED *(if any)*			
PCT/EP99/05619	3 August 1999				

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)
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Combined Declaration for Patent Application and Power of Attorney (Continued)
(Includes Reference to PCT International Applications)

Attorney's Docket 4070-57PUS

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 01/17/01	DATE 01/18/2001	DATE 01/18/2001
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE 01/18/01	DATE 01/18/2001	DATE